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Social & Economic Acceptability of Conservation Buffers

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SOCIAL AND ECONOMIC ACCEPTABILITY OF CONSERVATION BUFFERS

Introduction

One of the major goals of conservation programs is to reduce environmental pollution by establishing conservation buffers on privately owned lands. Lack of active participation by target groups was responsible for the non-realization of this goal. Since many landowners make decisions on adoption outside of a conventional economic context, there is the need to understand the decision-making processes governing the adoption or non-adoption of conservation practices by target groups. An understanding of this nature may yield necessary information that will guide the designing and implementing of more effective programs that may have greater positive impact on the adoption of conservation practices by landowners.

The major purpose of this literature review therefore, is to examine relevant literature on decision-making processes that guide people in making choices to adopt or not to adopt conservation practices from available options or alternatives, and taking steps to implement the choices. The specific objectives were:

1) to examine relevant literature on the decision-making processes,

2) to identify and assess barriers to adoption of conservation, and

3) to generate useful information that may guide the designing and implementation of effective conservation programs for target groups.

Theoretical Framework for Decision-Making

Theoretical Approaches for Decision-making and their functions: Hammond et al. (1980) identified and elucidated a broad descriptive framework that encompasses six basic approaches from decision theory as it is developed and applied in the field of management science, to attribution theory as it is developed and applied in psychology. The origins of three of the six approaches, namely the Decision, the Behavioral, and the Psychological Decision theories lie primarily in economics, while the other three - the Social Judgment, the Information Integration, and the Attribution theories originated from psychology. A summary of the theories now follows:

The Decision Theory (DT): Credited to Keeny & Raiffa (1976), this theory presents the perspective of choosing among alternatives with multiple attributes, the principal parameters of the process of choosing one alternative over another being the probability of the occurrence of the alternative, and its utility to the decider. The criterion set forth by the logic of the mathematics of choice is fundamental to this theory. Since evidence have shown that this criterion was not met, decision theorists have developed means of assisting decision makers to achieve rationality by bringing their cognitive activity in conformity with the demands of logic. DT then has essentially become a means for prescribing what the decision process should be, if it is to be rational.

The major aim of DT is to elaborate the logical entailments of the subjective probability and utility theory, and extend them to a variety of circumstances by means of mathematics, the criterion for the validity of the theory being its logical mathematical consistency. Once developed, the theory stands as a logical structure for decision making. One major flaw of this theory however, is the presumed departure of decision making

from DT because human decision-makers do deviate from mathematical logical reasoning in making decisions.

The Behavioral Decision Theory (BDT): Attempts to explain why human decision makers deviate from the logic of DT gave rise to BDT which intends to describe departures from optimal decision-making in empirical detail in contrast to DT, and to explain such departures in terms of both external (task) and internal (psychological) conditions. According to the authors, the best known description of a departure from optimal decision-making is "conservatism" which signifies the putative failure of decision makers to revise their posterior subjective probabilities as much as they should upon the receipt of new information. Therefore, the intended function of BDT is to reconstruct, if, as, and when need be, the already worked out theory of decision or choice behavior, on the apparent assumption that such theories intend to be, and should be a true description of the behavior of persons making decisions. This action would then place a powerful prescription for decision making in the hands of decision analysts who would then provide "tools" for decision makers.

The Psychological Decision Theory (PDT): Credited to Kahneman and Tversky (1972), PDT took a psychological approach and went beyond description to explanation and prediction of decision behavior. It attempts to find the cognitive sources of the departure from the criteria of rationality, and seek the manner in which the processes of memory, perception, and specific varieties of experiences, lead decision makers to develop systematic errors in their estimates of the probabilities and utilities that are the key parameters in DT. Rooted in DT, the intended function of PDT is to move us from a sheer behavioral path to a psychological path that explains why decision-makers behave

the way they do. It tries to identify some important behavioral phenomenon, for example, like departure from optimal choice, and adduce some psychological concepts, for example, like availability or representativeness. Based on this information, PDT then tries to predict or indicate when decision-makers are apt to "replace the laws of chance by heuristics." The theory also intends to find out whether biases occur in the cognitive activity of the decision making process, and offers suggestions as to how specific biases might be removed in a process named "debiasing" which is intended to rectify errors of inputs to decisions. This dimension of PDT is in contrast to DT and BDT where decision aids are intended to rectify errors of information aggregation, taking the inputs as given.

It is pertinent to note that these decision theories may fail to explain or predict the adoption behavior of many conservation practices by landowners and farmers. The findings of a study conducted by Napier and Camboni (1993) revealed that the theoretical approaches had limited utility for predicting the use of farming practices employed at the farm level. In their study titled "Use of conventional and conservation practices among farmers in the Scioto River Basin of Ohio," seven of the nine theoretical models utilized failed to explain much of the variance in the adoption behaviors examined, and the regression coefficients were not consistent with theoretical expectations. Some of the farm practices (variables) examined included Fall tillage, Conventional tillage with 1/3 ground cover at planting time, No till, and Conservation tillage with 1/3 ground cover at planting time. The findings suggest that adoption of specific farming practices will probably be difficult to predict, particularly if an environmental approach is emphasized. This is because concern for the environment apparently neither acts as a major barrier to use of farm practices that contribute to pollution, nor as a major facilitator of use of

conservation practices. The need to develop alternative approaches that could predict adoption of farming practices and frequency of use was stressed, with emphasis on measures of profitability and farm specialty. Until good predictive models concerning conservation practices are developed, expensive and non-cost effective conservation programs will continue to be implemented with little or nothing to show for the efforts involved.

Lockeretz (1990) summarized the areas of conservation that have received researchers' attention in the past. They include three aspects of farmers' acceptance and use of conservation practices – 1) Attitudes of farmers towards conservation and perceptions of the seriousness of erosion, 2) Use of specific practices such as conservation tillage, and 3) Results of conservation efforts as measured by the erosion rate or by the fractional or absolute reduction in erosion brought about by conservation practices. He noted that many studies investigated just one of these aspects, but some combine several into a more comprehensive analysis like first treating farmers' perceptions as a dependent variable, and then using it to predict farmers' practices. The explanatory variables used by most studies reflected one of three schools of thought:

a) That economics is the main consideration b) that farmers adopt soil conservation according to the same pattern as other innovations – the adoption / diffusion model so thoroughly studied in rural sociology, or c) the adoption process is specific to innovations concerned with environmental quality rather than economic return.

Despite this considerable effort, the author lamented that very little light has been shed on our understanding of why farmers adopt or fail to adopt conservation practices. Different approaches to research were suggested To improve our understanding, different

approaches to research were suggested such as using other kinds of explanatory variables like the external forces that shape farmers' values during their formative years having a continuing effect that cannot be discovered just by focusing on demographic variables like personal characteristics of the farmer such as age, education, and years of farming experience. Another alternative variable suggested was to find out whether the local social environment for conservation makes a difference or not.

Flach (1990) studied the effect of adopting a particular conservation practice on the possibility of adopting another conservation practice. He argued a case against low-input farming systems being non-compatible with the most modern and in many places, most effective soil conservation technology, as many people believed. He cited the successful experience of a low-input farmer, Dick Thompson of Boone County in Iowa, who routinely uses a ridge-till system in which he keeps a cover of plants, crop residue, or even weeds on soil during most of the year, and by so doing, effectively minimized erosion on his land. The results of a study conducted by Jackson (1988), in which a very traditional low-input Amish farm were compared with an adjacent farm that uses modern no-till technology, showed similar results. The Amish farm convincingly showed little soil erosion and that crop rotations that include legumes and liberal manure applications, combined with the use of horses rather than heavy tractors, greatly improved soil quality on the Amish farm. Through this management system, organic matter content and consequently, aggregate soil stability are increased, and bulk densities are decreased. The result was that water infiltration rates in the cornfields of the Amish farm were about seven times as high as those on the same soil under conventional no-till. These two examples convinced Flach (1990), that low-input farming and soil conservation are not

only compatible, but also actually mutually supportive. He concluded that all that is required will be more flexible conservation planning, and a willingness on the part of both conservationists and low-input farmers to cooperate and change long-held negative beliefs.

Hoag and Jack (1990) observed that the decision of agricultural producers to participate in government conservation programs is highly farm-specific, and depends on individual factors such as weather, historical production, current base acreage, the proportion of base to total acreage, slope of the land, and slope length among others. A study conducted in Stanley County, North Carolina, looked at the linkage between conservation compliance and adoption of low-input practices on a composite 100-acre farm.

The conservation compliance provision of the Conservation Title XII denies virtually all government program benefits to persons who produce an agricultural commodity or annual crop on a highly erodible field after January 1, 1990, without an approved conservation plan. Producers had until January 1990 to secure plan approval from the Soil Conservation Service (SCS) and had until 1995 to implement the plan fully. The benefits to those who comply with this provision included price and income supports, disaster payments, crop insurance, Farmers Home Administration loans, storage benefits, and farm storage facility loans.

The findings of this study suggested that conservation compliance can affect the adoption of low-input systems, and did indeed influence its projected profitability. Conservation compliance made low-input systems less economical than a soil conservation conventional system on a composite North Carolina farm with all of its

cropland in base. However, on a farm with less base it was profitable to escape conservation compliance by exiting the commodity programs to use a low-input system that resulted in more soil erosion. The study found that when commodity programs are a major part of a farmer's income, conservation systems will be the most important objective, even at the risk of sacrificing a low-input system. However, when the benefits of the program are insufficient to justify compliance, a farmer may switch to any rotation desired, which may or may not motivate a switch to low-input sustainable system.

Nowak (1992) offered two basic reasons why farmers do not adopt new production technology namely, 1) they are unable 2) they are unwilling. According to the author, these two reasons are not mutually exclusive as farmers can be able yet unwilling, willing but unable, and both unwilling and unable to adopt new technology or practice. He argued that answers to the questions why farmers or target audience do not adopt any new technology or practice must form the basis for increasing adoption. He then went further to elucidate nine reasons for farmers' inability to adopt, and seven reasons for unwillingness to adopt. It is pertinent at this juncture to summarize these reasons because the author also offered what he called "appropriate remedial strategies."

Table 1: Reasons for non-adoption of new technology or practice (By Pete Nowak, Dept. of Rural Sociology, University of Wisconsin, Madison)

Inability to adopt new technology	Suggested Remedial Strategy	Unwillingness to adopt new technology	Suggested Remedial Strategy
1. Basic Information for making decisions is lacking or scarce	Generation and distribution of basic information to those who need it	Information conflicts or inconsistency about the practice	Develop consistent information base, offer explanation for any existing legitimate differences
2. Cost of obtaining information too high	Reduce cost by increasing accessibility	Poor applicability and relevance of information	Generate and distribute relevant information on local basis
3. Complexity of system too great	Redesign or simplify the technology	Conflicts between current goals and new technology	Develop flexible systems
4. New technology too expensive	Redesign technique to reduce labor requirements or subsidize cost of adoption decision	Ignorance of farmer or promoter about new technology	Design education programs based on needs of potential adopters relative to factors critical to adoption
5. Excessive labor requirement cost relative to farm capabilities	Redesign new technique to reduce labor requirements or subsidize labor hiring	New practice inappropriate for the physical setting	Specify physical applicability of new technology, or redesign to adapt to different settings
6. Planning horizon too short relative to the time associated with recouping initial investments, learning costs, etc.	Redesign system or subsidize short-term unprofitable decision	New practice increases risk of negative outcomes	Increase information for calculating possible outcomes or subsidize risk to farmer
7. Limited availability and accessibility of supporting resources	Build capacity of local assistance network to meet local demands	Belief in traditional practices that represent least risks in markets	Demonstrate superiority and less risk of new way relative to the old
8. Inadequate managerial skills	Provide skill-building assistance for all categories of potential adopters		
9. Little or no control over adoption decision	Identify and focus efforts on actual decision makers or organizations		

Curtis and DeLacy (1995) conducted a study in Australia titled, "Evaluating land-care groups in Australia: How they facilitate partnerships between agencies, community groups, and researchers," Their findings tend to corroborate Nowak's (1992) suggested strategy of building the capacity of local assistance network to meet local demands in order to achieve sustainable resource use within a local community. This involves the readiness of the government to adopt a "grass-roots approach to development" instead of the typical "top-down approach" that characterizes most government programs. Although land-care in Victoria was a government program, the authors stated, " from the beginning the emphasis was on developing and maintaining a genuine grass-roots approach, and groups are free to define their own objectives and program of activities.

According to the authors, land-care groups emerged during 1986 as an alternative approach to achieving sustainable resource use in rural Australia, and have been embraced by the government as a model for effective community action towards more sustainable resource use. Land-care in Australia is a partnership between government and local communities that attempts to combine the technical expertise, access to funding sources, and commitment of agency staff with the indigenous knowledge, skills, and on-ground work of enthusiastic local participants. The key assumptions underlying land-care are that with limited government funding, the process of community development should be facilitated to produce more aware, informed, skilled, and adaptive resource managers, and thereby result in the adoption of more sustainable natural resource management practices. On this premise, most land-care groups developed in rural Australia with voluntary membership open to any member of the local community, and are responsible for mobilizing community action to adopt sustainable land practices. The groups are

responsible for committing themselves to implementing sustainable land use practices, while the government provided technical assistance with leadership and organizational skills training and additional funding to undertake important land-care work.

The effectiveness and success of these land-care groups have been demonstrated in the number of trees planted, length of fencing erected to control stock access to sensitive areas such as water courses and remnant vegetation, area of perennial pasture established, and number of pest animal, weed, erosion, and salinity control activities. In addition, the number of members undertaking whole farm planning as a percentage of group membership has been on the increase. These activities have been combined with increasing area of demonstration sites, field days and farm walks, meetings, and increasing number of landowners that are group members.

Campbell (1991) described this success of the land-care movement in achieving sustainable land use in rural Australia as "undoubtedly the most exciting and significant development in land conservation in Australia." On the gender side, the groups have successfully integrated a large number of rural women as members who constituted 34% and 47% of membership and secretary positions respectively. However, Curtis et al. (1994) reported that participation and experience of land-care was affected by gender because women were apprehensive about joining land-care groups. They claimed that they were often denied a voice in group decision-making because men did not acknowledge their role as important land managers with considerable expertise in land management. The author then recommended that groups provide a greater variety of experiences that reflect the interests of women, and provide opportunities for all family members to participate in land care.

Eaheart (1992), reminiscing on the ten years of success of the Missouri Wildlife Conservation Program, implied that the assignment of a resource person who should also be a specialist in a conservation program was a step in the right direction. In the case of the north central area office of the Missouri Department of Conservation (MDC), the assignment of a wildlife biologist to act as a liaison officer between MDC and the Soil Conservation Service (SCS), yielded positive results. According to the author, the wildlife biologist provided needed information and technical assistance to both MDC and SCS employees, and is answerable to both programs, although he is basically an MDC employee. Each MDC biologists worked with and trains SCS employees in such areas as wildlife management and plant identification, and has limited contact with landowners per se. SCS personnel then use the training they receive to offer suggestions to producers when working on conservation plans. With this arrangement, the number of landowners who can be reached on wildlife issues is unlimited. This cooperation has proved effective in getting more work done and serving the clientele better.

A study conducted by Duff et al. (1991) to ascertain soil conservation behavior and attitudes among Ontario farmers toward alternative government policy responses revealed that education, technical advice, universal financial incentives, and tax breaks, are much more favored among farmers as motivation to adopt conservation practices. Decisions to use soil conservation measures on the farm can be hampered by certain conditions, chief of which were inability to secure sufficient funding to finance the adoption, farm trial possibility, and availability of government financial support in form of grants or loan guarantees. Differences among farms and farmers and in the ways decisions are made could also affect adoption of soil conservation practices. Differences

among farms included farm size, type of crops grown, proportion of different soil textures (coarse, medium, or fine), proportion of different field slopes (gentle, moderate, or steep), and the type of available primary tillage implement. Differences among farmers could be demographics, farming experience, education, intergenerational expectations, and management skills. Others were personal attitudes toward farming, risk, soil conservation, type of operation, and ownership and tenure arrangements.

While the ideal program of treating each farmer individually and prescribing individual solutions is not a feasible option, the study recommended that farmers be classified into groups and then prescribe different policies for each group. Three approaches to grouping farmers were suggested: 1) by the relationship between conservation needs and actual farmer behavior, 2) by the apparent influences on conservation behavior, especially constraints, and 3) by the degree of receptivity of individuals to increasing their conservation efforts. Whichever way is chosen, the authors concluded that rejection of universality or "one cap fits all" paradigm, and focusing attention on the variability of groups' constrained operating environment, will be necessary to devise more efficacious mechanisms to reduce land and other environmental degradation.

Napier and Napier (1991) observing that knowledge is an important determinant of how conservation programs are perceived, and believing that people cannot be expected to exhibit positive attitudes towards conservation programs if they are unaware of the benefits and costs associated with participation, conducted a study to find out the perceptions of conservation compliance among farmers in a highly erodible area of Ohio.

The findings revealed that farmers who exhibited the most positive behavior toward conservation compliance were those who:

- Perceived that conservation compliance will produce benefits for their farming operations
- believed that farmers do not have absolute rights to land
- reported greater awareness of agriculturally induced pollution
- reported greater knowledge of conservation compliance
- believed that conservation compliance will not change production costs substantially, and
- participated in more federal farm programs.

However, potential loss of farm-level decision-making due to government intervention reduced favorability towards conservation compliance among respondents who believed in absolute rights of landowners. It was recommended that conservation agencies continue to provide information about the potential benefits to be derived from participation without camouflaging the impacts of conservation compliance on production costs at farm level.

The findings of a study conducted by Esseks and Kraft (1991) agreed with the importance of providing landowners or operators with adequate information about the potential benefits of participating in any conservation program. The study investigated land-user attitudes towards implementation of conservation compliance farm plans among 415 producers at five Midwestern sites, and found three sets of producer attitudes that should be conducive to the successful implementation of the 1985 and 1990 farm bills' conservation compliance provisions. They were: a) producers with approved plans

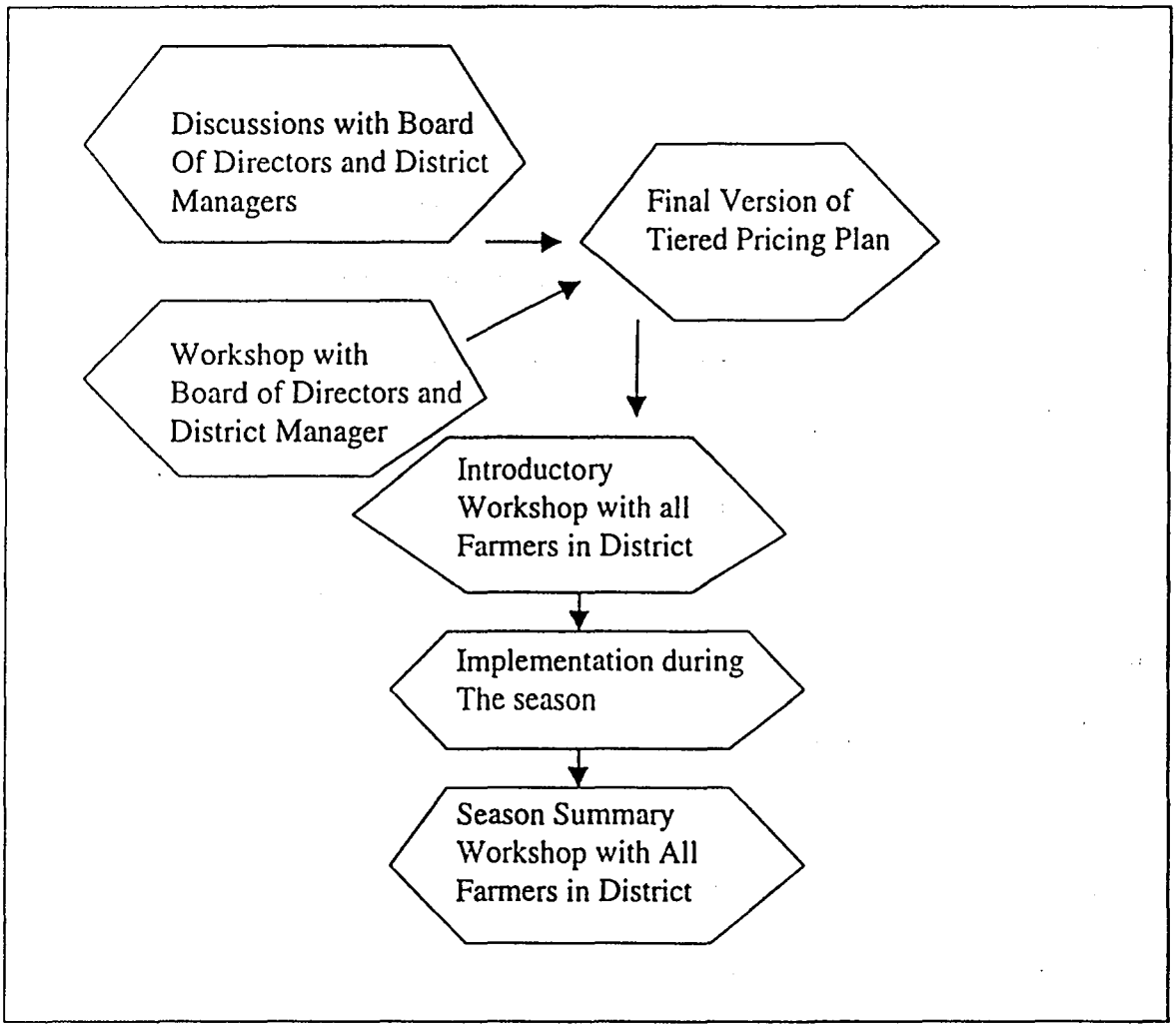
tended to regard them as tolerable in terms of their financial risks and the resources required to implement them. b) most producers were aware of the penalties resulting from non-compliance and c) most found it likely that violations will be detected and penalized. The non-respondents holding opposing attitudes constituted a minority in the survey areas investigated.

The trial implementation in 1988 of an alternative approach to water use and pricing proved to be an effective motivation for farmers at a San Joaquin Valley in California to implement water conservation practices. Wichelns and Cone (1992) in a study titled "Tiered pricing motivates Californians to conserve water," reported that the positive results obtained in subsequent years prompted the district's board of directors to adopt the tiered pricing as a permanent district policy. The success of the conservation program was demonstrated in the observed changes in irrigation practices, reduction in water deliveries, and the quantity of rain water collected, all of which constituted the goals of the program. The estimated field delivery ratios for cotton, tomatoes, melons, sugarbeets, and alfalfa seeds were higher in both 1989 and 1990 than during any of the previous three years, while water use efficiency increased by 17% in 1990 compared to the 1986 through 1988 period. Figure 1 shows the diagrammatic Plan for the Designing and Implementing of the Tiered Pricing Program.

The authors noted four components of the program that contributed to its success. They were 1) Involvement of the district board in designing and updating elements of the pricing program, 2) The timely exchange of information among district farmers 3) Establishment of prices and tiering that represent realistic goals and are relevant to local conditions, and 4) Collection of field-specific data describing water deliveries,

irrigation events, and other cultural practices. It is relevant to comment here that the farmers were given required information including the proposed cost of adopting the water conservation practices, and this helped them to plan and make decisions.

Figure 1: Designing and Implementing the Tiered Pricing Program at Broadview, California (Reference – Wichelns and Cone, 1992)


Discussions with Board Of Directors and District Managers
Final Version of Tiered Pricing Plan
Workshop with Board of Directors and District Manager
Introductory Workshop with all Farmers in District
Implementation during The season
Season Summary Workshop with All Farmers in District

Hawn and Getman (1992) also documented how cooperative and inter-agency assistance to Conservation Reserve Program (CRP) contract holders in Montana resulted

in some model acreages from the standpoint of soil erosion control and wildlife habitat development. The Private Lands Program of the Fish and Wildlife Service (FWS) signed a contract with one Lee Berry, a landowner, to develop wetlands habitats with CRP so as to improve the populations of waterfowl continental duck which were at record lows at the period. Water scarcity was a limiting factor, and interested private landowners can receive funding assistance to cover most of their costs for seeding mixtures. With assistance from FWS, Berry planted nearly 24,000 feet of tree rows consisting of more than 4,400 trees on his land, three ponds were constructed and food plots were added. The efforts of Berry and other participating landowners produced a rich diversity of habitat, which resulted in phenomenal changes in the wildlife species present and their populations in the area.

The authors reported that when hesitant landowners witnessed the obvious benefits to participating landowners, interest soared beyond the human and financial capabilities of the agencies involved. The implication was that landowners favor programs that provide an annual income, improve the equity in their land, and allow them a decisive role in management. In many situations, the landowner's objectives can be met and funded cooperatively among agencies in a way that multiple resource benefits can occur. The authors concluded, "Everyone gains through these cooperative ventures. Decisions are made at the local level, and the land is treated according to its suitability. -- -------- and a healthy relationship is established between landowners and the government agencies involved." They advised that flexibility and creativity in managing natural resources are critical to the success of public programs.

Surprisingly, a similar study on Maryland farmers revealed that cost sharing appeared to have little or no effect on the farmers' adoption of conservation practices. The study was conducted by Lichtenberg and Lessley (1992) to investigate the perceptions of Maryland farmers regarding the use of best management practices (BMPs) to reduce water pollution from non-point sources with technical and financial assistance from conservation programs established for the purpose. Best management practices are defined as farming practices that reduce soil and nutrient losses at reasonable cost. The authors contended that farmers' perceptions of cost sharing and the value of alternative information sources provided a measure of success of the principal policy initiatives for promoting the use of BMPs.

The study's findings were inconclusive since the researchers identified several other variables that could impact adoption itself. For example, the conservation program had limited target constituency, at least in Maryland, and thus the cost-efficiency of the program is likely to be low. Also, at the time of the survey, the outreach program aimed at creating awareness among Maryland farmers of the existence of the cost-sharing program was deemed insufficient, with the result that too few farmers were aware of the program. An analysis of the outreach program suggested the need for definite improvement since 40% of the respondents reported receiving no information on the issues from any source.

Another study conducted by Mountjoy (1996) suggested that although ethnicity may not be the primary determinant of farming behavior, ethnic group membership offers a strong indicator of the type of conservation system, in this case, soil control, that a farmer uses. The study focused on the knowledge systems and soil erosion control practices of 46 ethnically diverse strawberry farmers on the highly-erodible hills of the

Elkron Slough Watershed in Monterey County in California comprised of American, Hispanic, and Japanese origins. The findings suggested that the importance of farm enterprise characteristics like farm size, land tenure, debt-asset ratio, and farm income in explaining conservation management behavior, increased when these factors were linked with the ethnicity of the farmers. While access to financial capital was found to be critical, the price received, the source of production credit, farm size, and gross income, became the most important economic predictors of the farmers' ability to invest in soil erosion control practices. Ethnicity was also found to be highly correlated with the production investment strategy, trusted sources of farming information, and management styles of the farmers. The author concluded that recognition of the social and cultural context of individual behavior required a rethinking of soil conservation research and policy in that a conservation program that successfully promotes change with one group may have different results, or no results, with a group that thinks differently or has different resources.

Education as a conservation tool

Many studies have proved that when combined with other support services, education of target audiences could enhance the successful adoption of conservation practices. Shelton et al (1991) documented a success story of a comprehensive educational program that was developed to enhance the adoption of conservation practices by landowners in the northeastern area of Nebraska. Developed by a combined team from the University of Nebraska Cooperative Extension (CE) and the Soil Conservation Service (SCS), the major goal of the educational program was to increase

adoption of conservation tillage and no-till planting methods by 10 to 20 percent. Major features of the educational program were:

a) an awareness of either a problem or the new technology

b) recognition of the problem's cause and one's ability to change the situation

c) Technical and economic information, assistance, and support for making the change.

It is pertinent to note that every step of the process incorporated a wide range of producer knowledge and experience, and provision of well-defined information that addressed specific farmer needs. The economic incentive offered was a $25-per-acre payment to each participant for up to 10 acres. The educational strategies used included field days on local farmers' fields that made good allowance for farmers to ask technical questions of extension personnel, cooperative implement dealers and equipment owners. Others were demonstration plots comparisons, meetings, equipment clinics, media, newsletters, and provision of basic information on crop yields and crops, as well as brochures describing conservation practices and directions to demonstration sites.

The concerted efforts yielded good fruits in that specific project goals were met or surpassed. For example, in 1986, none of the 42 sampled fields had a 30 percent or greater residue cover, and only one field had no-till planting. But in 1989, 12 percent of the sampled fields had a 30 percent or greater residue cover while 22 percent were no-till planted an increase of nearly tenfold from 1986 situation. Significant improvement in adoption was also reported for other conservation practices.

In another study conducted by Hill and Lake (1992) titled "PEP$: A dollar-and-cent approach to conservation tillage," educational assistance to participating farmers also

constituted a major component of Indiana's T-by-2000 program seeking to reduce soil erosion and sedimentation significantly throughout the state by the year 2000. The educational goal of PEP$ was to help participating farmers evaluate ways to maximize net economic returns per acre and reduce soil erosion to tolerable levels. Additionally, the data collected from participants' farms were used to further substantiate the environmental and economic advantages of using conservation tillage.

Educational support for participants included the provision of technical information, documentation of farming activities from planting to harvest, and assistance in calculating net returns and yield rankings. Groupings allowed for comparison of cropping systems on similar soil types. The results were then published and made available to all participants and interested parties or individuals. Local and regional meetings were then held to allow participants to share information about their cropping systems, and interact with each other as well as with agribusiness representatives and university extension staff. The authors reported that participating fields have been exceptionally productive and profitable. The conclusion was that economic information including production efficiency should be a major focus of farmer-directed conservation education.

Farmer to farmer education as a tool to improve conservation adoption is another approach that has been reiterated by many researchers. According to Enshayan et al (1992), there are many farmers whose practices and general approach to farming exemplify innovation, resource conservation, soil restoration, and economic viability. Such farmers represent a wealth of practical local knowledge of farming and land stewardship. "Learning by doing, or knowledge rooted in direct experience, is recognized

by educational researchers as the most meaningful and enduring form of knowledge," the authors stated. Yet another study undertaken by Michalson and Papendick (1991) featured a regional model for environmental research and education aimed at solving conservation problems in the Pacific Northwest. Called STEEP, an acronym for Solutions To Economic and Environmental Problems, the research program was designed to develop coordinated and integrated soil erosion strategies and practices for the three Pacific Northwest states. The quality of the program was demonstrated in the active participation of local farmers and wheat producer organizations both of who provided major input into the development and operation of the research and extension programs. The growers sought support for STEEP, assisted in establishing research priorities, and helped established committees in coordinating existing research projects. They also suggested new problem areas and needs for future research based on their own experiences. In addition, they participated in the annual reviews and workshops, and were largely responsible for the addition of the extension component of the program.

STEEP's accomplishments included a positive change in farmer attitudes towards erosion control and implementation of erosion control practices, and the development of superior tillage and plant management practices. Others were integrated technology transfer that featured the development of educational materials like the Conservation Farming Update quarterly, the software user's manual and optional farm plans for conservation compliance. Overall, STEEP has created increased public awareness of soil erosion problems and their consequences. It has also made growers more receptive to implementing soil and water conservation measures.

A residue management decision support system or RESMAN is yet another tool for conservation education developed to aid land managers in making decisions about adopting soil conservation practices. According to Scott (1991), RESMAN is a computer-based decision support program for crop residue management that uses crop type and yield information provided by the land user to establish the initial amount of residue left on the soil surface following harvest. This is a much more accurate technique than using crop yield estimates to assess the residue left on the field after harvest. The actual field estimates for the residue mass provide greater accuracy, an information few landowners have, with the additional advantage of being able to correct for known varietal differences. RESMAN then uses this information combined with others to advice the landowner about the possible outcome of different conservation management options available to the landowner. Thus RESMAN became a very useful decision making tool for adoption of soil conservation practices.

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SOCIAL AND ECONOMIC ACCEPTABILITY OF CONSERVATION BUFFERS

LITERATURE SUMMARY

1)Use of conventional and conservation practices among farmers in the Scioto River Basin of Ohio

Citation: Napier T. L. & Camboni S. M. (1993) Journal of Soil and Water Conservation, (48)3, p 231-237.

Hypothesis: The theoretical perspective developed from selected components of diffusion and the farm structure model has limited utility for predicting adoption behavior at the farm level.

Conservation practices examined: a) Fall tillage

b) Conventional tillage with 1/3 ground cover at planting time

c) No till

d) Conservation tillage with 1/3 ground cover at planting time

Population/Sample: 1,305 farm owner/operators in the Scioto River watershed of Ohio.

Measures: Frequency of Use of conservation practices a) to d) when compared to other practices namely:

e) Ridge tillage

f) Deep plowing

g) Use of banded fertilizer

h) Fall application of fertilizer

i) Soil testing

j) Winter application of manure

Results: The Diffusion theory was not very useful for understanding frequency of use of the farming practices assessed, neither did the statistical model explained much of the variance observed in the adoption behaviors of the farming practices.

2) Soil and water conservation down on the farm: A changing economic landscape

Citation: Ervin David E. (1994) Journal of Soil and Water Conservation, (49)3, P.232-234.

Hypothesis: Lack of good understanding of farm-level conservation behavior fails to give a consistent explanation of why some farmers practice conservation and others do not.

Type of conservation practice: General.

Sample: General.

Results: Identification of powerful forces that will change farm-level economics of soil and water conservation. They are:

1) Falling large government subsidies despite the fact that subsidies help in increasing conservation adoption.
2) Possibility of farmers and ranchers facing prices and costs more aligned with world market forces and less with commodity support programs.
3) Increase in state and local environmental regulations that can increase production costs to reduce soil and water externalities.
4) Availability of increasingly sophisticated management technology to process economic information, meaning that soil and water conservation decisions will receive greater economic scrutiny down on the farm.

Measures: a) Rate at which local and state environmental regulations are being enacted and imposed on farmers.

b) Rising incomes for non-farm population.

c) Demand for environmental quality in both rural and urban areas.

d) Political dynamics and power shift away from agricultural groups.

Results: 1) Growing incentives to economize on conservation expenditures

2) Much greater emphasis being placed on whether conservation meets the economic bottomline without large government subsidies.

3) Possible transformation of the roles of soil and water conservation professionals in delivering assistance.

4) Increasing empowerment of farmers to do economic analysis of farming options available to them through the myriad hard and soft technologies of the information revolution.

5) Likelihood of farmers responding less to arguments to change their conservation behaviors if the economic consequences are not favorable.

Conclusion: Need for conservation programs to be sensitive to, understand, and appreciate the powerful economic forces in order to effect more cost-effective programs in the face of tight budgets.

3) Impact of conservation practices on airborne dust in the southern High Plains of Texas

Citation: Ervin R. T. & Lee J. A. (1994) Journal of Soil and Water Conservation, (49)5, p.430-437.

Hypothesis: Conservation practices affect the level of airborne dust in the southern High Plains of Texas.

Type of conservation practices investigated:

1) Long-term enrollment in either the Soil Bank or Conservation Reserve Program (CRP) involving long-term land retirement
2) Temporary cover for erosion control
3) Conservation tillage systems
4) Strip-cropping

Population/Sample: Population consists of farmers and landowners in the southern High Plains of Texas. Sample was the Lubbock area.

Measures: a) Hectares of farmland enrolled in the programs.

b) Annual Palmer Drought Severity Index for Texas High Plains
c) Relationships between dust and various land practices using regression model.
d) Impact of selected variables on the annual level of dust
e) Automobiles, farm machinery etc. etc.

Results: Except for strip-cropping and temporary cover practices, evidence showed that other land practices influenced the amount of airborne dust in Lubbock, Texas.

Recommendations: Agricultural producers in Texas are encouraged to adopt those land practices that decrease the level of airborne dust if the cost of such practices are lower than the value of the reduction in airborne dust.

4) What have we learned about who conserves soils?

Citation: Lockeretz, William (1990) Journal of Soil and Water Conservation, (45)5, p. 517-523

Hypothesis: Research so far conducted told us very little about a topic we need to know very much about – "Which farmers conserve soil and why?"

Type of conservation practices: General soil conservation practices.

Sample: General

Measures: 1) Farmers' acceptance and use of soil conservation practices as measured by:

a) Attitudes towards conservation and perceptions of the seriousness of soil erosion
b) Use of specific practices such as conservation tillage
c) Results of conservation efforts as measured by the erosion rate or by the fractional or absolute reduction in erosion brought about by conservation practices

2) Critique of the research approaches engaged in the investigations, e.g. the statistical analysis method of multiple regression analysis, and researchers sticking to the use of common explanatory variables at the expense of other kinds of variables that may explain the variance in farmers' conservation behavior and offer needed information to guide policy.

Results: Failure of statistical analysis methods to relate farmers' conservation attitudes and behavior to personal, institutional, or farm structure variables as revealed by critical examination of the analysis methods and the manner of representing the results.

Conclusions: 1) Statistical presentations often overemphasize the positive findings and understate how much has not been learned.

2) Many studies have been hemmed in by too narrow a set of preconceptions so other variables that might be relevant have not been explored.

3) We do not know enough about how soil conservation behavior varies geographically and over time for the results to be of much use in guiding policy.

Recommendations: a) Use of other kinds of explanatory variables different from the common ones in explaining the variance observed in farmers' conservation behavior.

b) Linking studies undertaken at different places and different times.

5) Low-input agriculture and soil conservation

Citation: Flach, Klaus W. (1990) Journal of Soil and Water Conservation, (45)1, p. 42-44.

Hypothesis: The objective of sustainable agriculture and soil conservation can be compatible and complementary.

Type of conservation practices: 1) Conservation tillage

2) Low-input farming systems

Sample: Dick Thompson's low-input farm in Boone County, Iowa, an Amish farm, and a modern no-till farm, both in Holmes County, Ohio.

Measures:

a) Extent of soil erosion as measured by the Universal Soil Loss Equation (USLE)
b) Soil organic matter content
c) Soil aggregate stability and bulk densities
d) Water infiltration rates and run-off in the corn fields
e) Type of crop rotations used.

Results: Evidence from Dick Thompson's farm showed that effective soil erosion control has been achieved without compromising the profitability of the production business. Rotations that included legumes and liberal applications of manure, combined with the use of horses rather than heavy tractors, reduced soil compaction and greatly improved soil quality on the Amish farm. Water infiltration rates in the corn fields of the Amish farm were about seven times as high as those on the same soil under conventional no-till in addition to little amount of run-off and soil erosion.

Conclusion: Low-input farming and soil conservation are not only compatible, but are also actually mutually supportive.

6) Low-input farming systems under conservation compliance

Citation: Hoag, Dana L. & Jack, Kevin E. (1990) Journal of Soil and Water Conservation, (45)1, p. 71-74.

Hypothesis: The decision of agricultural producers to participate in government conservation programs and adhere to conservation compliance rules is highly farm-specific. It depends on individual factors such as weather, soil type, historical production, current base acreage, the proportion of base to total acreage, slope of the land, and slope length, among others.

Type of conservation practices:

1) Soil erosion control (soil erosion is a very serious problem in the area investigated.)
2) Low-input agriculture that uses no commercial fertilizer or pesticides

Sample: Stanly County, North Carolina

Measures:

- Opportunity cost of lost commodity program payments and its impact on producer adoption of low-input systems
- Linkage between conservation compliance and low-input adoption
- Impact of conservation compliance on adoption of conservation practices

Results:

- Conservation compliance did indeed influence the projected profitability of low-input agriculture in Stanly County in that a farm with 100 percent of its cropland in program base would earn the most by participating in government commodity programs. The relative benefit of commodity programs was large compared to compliance costs in low-input systems that used all of the farm's base acreage.
- The conventional corn-wheat/soybean rotation was the most profitable system meeting conservation compliance rules. However, the most profitable low-input corn-wheat/soybean rotation, was no longer optimal with the introduction of conservation compliance because it exceeded the maximum allowable soil loss limit.
- Conservation compliance made low-input systems less economical than a soil-conserving conventional system on a composite North Carolina farm.
- Only those participating in government commodity programs were directly affected by conservation compliance that addressed certain disincentives for soil conservation in commodity programs.

Implications:

- Low-input sustainable agriculture systems that do not have a program crop on every acre each year might be avoided by farmers with a large proportion of base acreage
- When commodity programs are a major part of a farmer's income, conservation systems will be the most important objective. However, when the benefits of the program are insufficient to justify compliance, a farmer may switch to any rotation desired which may or may not motivate a switch to a low-input sustainable system.

Conclusion: The results demonstrated that low-input goals cannot always be achieved when conserving soil, especially because many low-input sustainable systems rely on tillage to compensate for reduced chemical use. Nevertheless, conservation plans could also contain low-input objectives.

7) Why farmers adopt production technology

Citation: Nowak, Pete (1992) Journal of Soil and Water Conservation, (47)1, p.14-16.
Hypothesis: New production technologies are adopted when the techniques are perceived as being in farmers' best interests. Overcoming the impediments to adoption of crop residue management techniques will be crucial to implementation of conservation compliance plans.
Type of conservation practices: New techniques such as residue management systems.
Sample: All farmers.
Measures: Reasons why farmers reject new production techniques.
Results: Farmers do not adopt new production techniques for two (2) basic reasons

1) They are unable to adopt because:
   - Information needed for sound economic and agronomic analysis for decision making is lacking or scarce
   - Cost of obtaining needed information is too high
   - Complexity of the technology is too great
   - Investment costs of adoption is too high and influence of technology on net returns not favorable
   - Excessive labor requirements
   - Planning horizon relative to the time associated with recouping initial investments, is too short
   - Availability and accessibility of supporting resources is limited

2) Farmers are unwilling to adopt because:
   - Information is conflicting or inconsistent
   - Applicability or relevance of information is poor
   - Current production goals and new technology conflict with each other
   - The farmer or the promoter of the technology is ignorant or has no opportunity to learn
   - The practice of the new technology is not appropriate for the physical setting of the farm operation
   - The practice increases the risk of negative outcomes
   - Lack of regard for traditional practices or indigenous knowledge

Implication/Recommendation: Many of these obstacles in the way of adoption are beyond the farmers' control. Therefore more attention should be given to understanding and addressing the many reasons why farmers are unable or unwilling to adopt conservation technologies. (See Table 1 for detailed information)

8) Evaluating land-care groups in Australia: How they facilitate partnerships between agencies, community groups, and researchers

Citation: Curtis, Allan & DeLacy, Terry (1995) Journal of Soil and Water Conservation, (50)1, p.15-20.

Hypothesis: The Australian approach to land conservation offers a very good model for effective community action towards more sustainable resource use.

Type of conservation practice: Land conservation practices involving:

- Tree planting and fencing
- Perennial pasture improvement
- Addressing specific land degradation problems e.g. rabbit infestation
- Whole –farm planning
- Conservation cropping embracing a range of tillage practices including minimum tillage, stubble mulching, and planting grain legumes.
- Government financial support

Sample: Land-care groups in rural Australia

Measures of group effectiveness:

- Number of trees planted
- Length of fencing erected to control stock access to sensitive areas like water courses and remnant vegetation
- Area of perennial pastures established
- Number of members undertaken whole-farm planting as a percentage of group membership

Measures of community participation included:

- Number of general meetings held
- Number of visitors studying or observing land-care group work
- Number of field days and farm walks held
- Percentage of land holders in an area who are group members
- Number of demonstration sites established
- Number of other promotional activities
- Participation and integration of women in the land-care groups, and their number in the executive set-up

Results: Positive trends were observed in all of the above measures except for the claim of women that they were denied a voice in group decision-making because men did not acknowledge their role as important land managers with considerable expertise in land management.

Recommendation: Groups should strive to provide a greater variety of experiences that reflects the interests of women, and provide opportunities for all family members to participate in land care.

9) Wildlife and soil conservation

Citation: Eaheart David (1992) Journal of Soil and Water Conservation, (47)4, p.289-291.

Hypothesis: Cooperation between conservation agencies can enhance the achievement of conservation goals and increase the adoption of conservation practices by landowners who otherwise might not participate.

Type of conservation practices:

- Planting grass borders around fields to prevent erosion
- Provision of valuable food and cover (warm-season grasses and cool-season legume mixture) for wildlife
- Listing of endangered species for programming and decision making
- Provision of wetland inventory and classification
- Fish and wildlife management practices
- Plant identification

Sample: Missouri wildlife land owners

Measures:

- Changes (increase or decrease) in the numbers of wildlife endangered species
- Amount of bio-diversity of plants and animals in the area
- Improved fish and wildlife management practices

Results: The wildlife biologist successfully coordinated the conservation activities of the two conservation programs – the Missouri Department of Conservation (MDC) and the Soil Conservation Service (SCS). Many land owners were reached and successfully persuaded to participate in conservation activities with the result that the numbers of wildlife endangered species and plant bio-diversity increased in the area, while fish and wildlife management practices became more sustainable.

10) Soil conservation behavior and attitudes among Ontario farmers toward alternative government policy responses

Citation: Duff, Scott N., Stonehouse, D. Peter., Hilts, Stewart G., & Blackburn, Donald J. (1991) Journal of Soil and Water Conservation, (46)3, p. 215-219.

Hypothesis: More efficacious conservation mechanisms can be devised by rejecting universality in government program design and focusing attention on the variability of farmer-groups' constrained operating environment.

Type of conservation practices: Water-related soil erosion control using the following practices:

- Till outlet protection
- Grassed waterway
- Treed windbreaks
- Crop rotation
- Strip-cropping
- Under-seeding
- Reduced tillage
- No-till
- Livestock manuring

Sample: Ontario farmers

Measures:

For farm unit decision-making are:

- Awareness of soil erosion problem
- Gathering of information about remedial measures
- Difficulties experienced in adopting particular measures
- Intention to further adopt new practices or expand on the old practices

For soil conservation behavior are:

- Actual soil conservation practices adopted

Results:

- 86 percent of farmers surveyed recognized soil erosion as a problem although there was a tendency for the perceived magnitude of soil erosion to decrease the closer to the home farm one gets
- Farmers tended to rate government sources of information as not important in their decision to use soil conservation measures
- Financial constraints to adoption were the most prevalent obstacle mentioned by the farmers
- Education and universal financial incentives were deemed to be more effective than other government policy options to increase adoption
- 69 percent of the farmers indicated an intention to start or increase soil conservation on their land
- The most popular conservation practices actually adopted by the farmers were crop rotations (90%), tile drainage (87%), livestock manuring (76%), tile outlet protection (70%), under-seeded crops (65%), and grassed water-ways (51%).

Perceptions of conservation compliance among farmers in a highly-erodible area of Ohio

Citation: Napier, Ted L. & Napier, Anthony S. (1991) Journal of Soil and Water Conservation, (46)3, 220-224.

Hypothesis: While positive attitudes of landowners toward conservation programs do not guarantee participation, negative attitudes certainly will impede participation.

Type of conservation practices: Soil erosion control practices in general

Sample: 371 land owner-operators in 5 contiguous counties in central Ohio

Measures:

1. Favorability of land owners towards conservation compliance
2. Perceived benefits of conservation compliance
3. Perceived knowledge of conservation compliance
4. Perceived impact of conservation compliance on farm-level production costs

Results:

1. Respondents were slightly favorable towards conservation compliance although only 6.2% strongly opposed compliance. Potential loss of farm-level decision-making due to government intervention reduced favorability towards compliance.
2. Respondents believed that compliance will offer little benefits to their business although only 7.9% indicated that compliance would harm their business
3. Most respondents have some knowledge of conservation compliance. More knowledgeable respondents exhibited a more favorable attitude towards compliance regulations.
4. Most respondents believed that compliance would produce slight to moderate increase in farm-level production costs.

Conclusion and recommendation: These findings suggested that considerable support existed for conservation compliance within the study area and it was recommended that conservation agencies continue to provide information about the potential benefits land owners could derive from compliance.

11) Land user attitudes toward implementation of conservation compliance farm plans

Citation: Esseks, J. Dixon & Kraft, Steven E. (1991) Journal of Soil and Water Conservation, (46)5, p. 365-370.

Hypothesis: Successful implementation of the provisions of the 1985 and 1990 farm bills depends on the cooperation of thousands of land users who must agree to apply and maintain appropriate soil conservation practices.

Type of conservation practices: Soil conservation practices in general.

Sample: 415 land owner- producers at 4 watersheds and 4 grain and livestock production sites in 5 states of the Midwest – Wisconsin, Missouri, Illinois, Iowa, and Indiana.

Measures:

1. Status of planning for conservation compliance
2. Effect of completed plans on earnings above production costs
3. Requirements for implementation of completed plans
4. Awareness of penalties for non-compliance
5. Likelihood of non-compliance being detected and penalized

Results:

1. Almost 74% of respondents had completed plans for conservation compliance
2. 64% believed that compliance would have no significant effect on earnings above production costs, 27% believed it would cause significant decrease, while only 7.4% believed it would cause significant decrease on earnings.
3. Most respondents believed that implementation of plan would require about as much as they were capable of doing.
4. Majority or about 80% of the respondents were aware of penalties for non-compliance.
5. Majority or about 84% perceived the likelihood of non-compliance being detected and penalized.

The findings suggested positive indications for the success of conservation compliance and that respondents were well informed.

12) Tiered pricing motivates Californians to conserve water

Citation: Wichelns, Dennis & Cone, David (1992) Journal of Soil and Water Conservation, (47)2, p. 139-144.

Hypothesis: Tiered pricing of water use is an effective motivation tool for providing economic incentive for farmers to manage irrigation water carefully and generate timely and accurate information for conservation partners.

Type of conservation practice:

Water conservation practices of:

- Reduction of the volume of drain water collected beneath farm fields
- Changing irrigation practices
- Reduction in water deliveries

Sample: 18 farms in San Joaquin Valley in California's Broadview Water District.

Measures:

1. Crop-specific estimated field delivery ratios (Estimated crop evapotranspiration – Effective rainfall / Depth of water delivered)
2. Volume of drain water and estimated constituent loads (salt, boron, and selenium loads) in drainage systems
3. Field – specific irrigation data
4. Farmers' attendance and participation at workshops

Results:

1. Higher values for field delivery ratios indicating more efficient irrigation management practices
2. Decline in average irrigation depths, volume of drain water collected, and constituent loads indicating a reduction in water use and waste water management costs
3. Positive changes in irrigation management towards sustainability
4. More farmers attending workshops to report on their work and share experiences with others

4 components of the program that contributed to its success were:

- Involvement of the district board in designing and updating elements of the pricing program
- Timely exchange of information among district farmers
- Establishment of prices and tiering that represented realistic goals and are relevant to local conditions
- Collection of field-specific data describing water deliveries, irrigation events, and other cultural practices

13) Enhancing CRP values

Citation: Hawn, Ted & Getman, Mike (1992) Journal of Soil and Water Conservation, (47)2. P.134-135.

Hypothesis: Maximum conservation accomplishments with landowners occur when personnel from agencies with programs to assist landowners coordinate and cooperate with each other.

Type of conservation practices:

- Soil erosion control
- Wildlife habitat development
- Planting of trees
- Mixed seeding for cover crops

Sample: Landowners in Central Montana

Measures:

1. Changes in wildlife habitat populations and species
2. Changes in populations of a rare species, waterfowls
3. Changes in pheasant population
4. Suitable wintering places for wildlife habitat populations
5. Number of trees planted to control soil erosion

Results:

1. Increases in populations of wildlife habitat species and populations
2. About 300 pheasants now have a place to winter in a 50-acre land where diverse seed mixtures now provide optimal cover and food needs
3. Another 700 acres now provide wintering cover for about 150 mule deer
4. Another 1,100 CRP acres also developed to provide food and winter shelter for about 150 to 200 elks
5. Suitable nesting cover for waterfowl and upland game birds
6. Over 4,400 trees planted and established on 24,000 feet of tree rows

14) Water quality, cost-sharing, and technical assistance: Perceptions of Maryland farmers.

Citation: Lichtenberg, Erik & Lessley, Billy V. (1992) Journal of Soil and Water Conservation, (47)3, p. 260-263.

Hypothesis: The extent to which efforts to promote the use of best management practices (BMPs) succeed depends on how well they are targeted, and this in turn depends on availability of information about current adoption patterns.

Type of conservation practices: Best management practices (BMPs) defined as farming practices that reduce soil and nutrient losses at reasonable cost. For example, conservation tillage.

Sample: Farmers and landowners in 4 agricultural regions of Maryland – Piedmont, upper and lower Eastern Shore, and southern Maryland.

Measures:

1. Changes in planned adoption of BMPs due to cost-sharing
2. Respondents' use and evaluation of alternative information sources
3. Farmers' perceptions of water quality problems

Results:

1. Cost-sharing increased planned adoption for few farmers
2. Outreach efforts on farmer-education needed improvements since 40% of respondents received no information on BMPs
3. Water quality problems perceived by farmers as someone else's problems

15) Ethnic diversity and the patterned adoption of soil conservation in the Strawberry Hills of Monterey, California.

Citation: Mountjoy, Daniel C. (1996) Society & Natural Resources, 9: 339-357.

Hypothesis: Although ethnicity may not be a primary determinant of farming behavior, ethnic group membership offers a strong indicator of the type of conservation system that a farmer adopts.

Type of conservation practices: Soil erosion control practices including:

- Buried drains
- Grassed roads
- Surface pipes
- Sediment basins
- Dispersion channels
- Plastic-lined ditches

Sample: Anglo , Japanese , and Mexican strawberry farmers on the hills of Elkron Slough Watershed in Monterey County, California.

Measures:

1. Ethnicity of farmers
2. Type of soil conservation practices adopted by farmers
3. Effectiveness of conservation practices in controlling soil erosion.
4. Farm enterprise characteristics – farm size, land tenure, farm income, debt-asset ratios
5. Economic factors of each farm
    - Access to financial capital
    - Prices received for farm products and gross income
    - Source of production credit
    - Farm size

Results:

1. Farmers' ethnicity were Anglo (n=5), Japanese (n=12), and Mexican (n=29)
2. Anglo farmers used buried drains and grassed roads with soil erosion control effectiveness of 90% and 80% respectively, Japanese farmers used surface pipes, sediment basins, and dispersion channels with effectiveness of 90%, 60%, and 90% respectively, and Mexican farmers used plastic lined ditches with 50% effectiveness.
3. While access to financial capital was found to be critical, the source of production credit, farm size, and gross income became the most important economic predictors of the farmers' abilities to invest in soil erosion control.
4. The importance of enterprise characteristics (farm size, debt-asset ratio, and farm income) in explaining conservation management behavior increased when these factors were linked with the farmers' ethnicity.
5. Ethnicity was also found to be highly correlated to the production investment strategy, trusted sources of farming information, and management styles of farmers.

16) A cooperative educational program to reduce soil erosion

Citation: Shelton, David P., Dickey, Elbert C., Jasa, Paul J., Biere, David A., & Krotz, Susan S. (1991) Journal of Soil and Water Conservation, (46)3, p. 169-173.

Hypothesis: Appropriate cooperative educational programs combined with financial incentives can increase the adoption of conservation practices by landowners and farmers.

Type of conservation practices:

- Conservation tillage
- No-till planting
- Use of relevant conservation information

Sample: Farmers in Logan Creek area of eastern Nebraska

Measures:

1. Number of terraces constructed
2. Acreage of grassed water-ways established
3. Change in use of conservation tillage and residue cover
4. Savings on soil erosion control
5. Attendance at the educational activities and participation

(The educational program included farmers' field days, demonstration of effectiveness of residue cover using rainfall simulator, demonstration plot comparisons of conservation tillage practices, provision of information on crop yields and costs, holding of equipment clinics, meetings, and use of media to create awareness of the programs, and establishment of newsletter and other publications.)

Results:

1. 304,250 feet of terraces with 125,072 feet of underground tile outlets were constructed on participants' land and farms
2. 30 acres of grassed water-ways were established
3. Use of conservation tillage was increased ten-fold. Residue cover use also increased resulting in 140,000 tons or 20% reduction in soil loss. Overall, soil erosion was reduced by 306,000 tons or by 43%.
4. The soil erosion reduction translated to significant savings in soil erosion control.
5. Good attendance and participation of land owners and farmers at the educational activities was reported

17) PEP$: A dollar-and-cent approach to conservation tillage

(PEP$ is an acronym for "Profit through Efficient Production Systems")

Citation: Hill, Peter R. & Lake, James E. (1992) Journal of Soil and Water Conservation, (47)2, p. 131-133.

Hypothesis: Provision of relevant information on the economics of agricultural production and efficiency can enhance the adoption of conservation practices.

Type of conservation practices:

- No-till system
- Mulch-till system
- Moldboard plow system

Sample: Corn and soybean farmers in central Indiana

Measures:

1. Number of farmer-participants in PEP$ program
2. Yields of corn and soybean crops
3. Net returns to farmers
4. Amount of savings due to use of the systems

Results:

1. A total of 160 farmers from 21 counties in central Indiana voluntarily participated in the program
2. Corn yield was an average of 150 bushels per acre, an increase of 20 bushels/acre over the state average
3. Soybean yield was 46.8 bushels/acre, an increase of 5.8 bushels/acre over state average
4. Savings in no-till increased and offset the higher pesticide cost

18) Farmer to farmer

Citation: Enshayan, Kamyar, Stinner, Deb, & Stinner, Ben (1992) Journal of Soil and Water Conservation, (47)2, p. 127-130.

Hypothesis: A mentoring program utilizing farmers' accumulated knowledge that exemplify innovation, resource conservation, soil restoration and economic viability, can be an effective tool to disseminate and pass conservation knowledge to other farmers.

Type of conservation practices: Holistic approaches to management including practices such as:

- Long-term crop rotations that included a forage legume in the cropping sequence. For example, a typical rotation included clover or alfalfa for 1 to 3 years, corn, soybeans, followed by either wheat or oats.
- Shallow incorporation of crop residues or manure with either disk, chisel, or shallow moldboard plow.
- Cultivation to control weeds using a rotary hoe and spike-toothed harrow.
- Planting a combination of legumes to improve soil fertility.
- Maintaining a diversity of life forms in the soil – invertebrates such as earthworms and microorganisms, to reduce pest incidence.

Measures: Rate of increase of conservation programs using farmers' accumulated indigenous knowledge all around the world.

Results: (Not stated)

19) STEEP: A regional model for environmental research and education

(STEEP is an acronym for Solutions To Economic and Environmental

Citation: Michalson E. L. & Papendick R. I. (1991) Journal of Soil and Water Conservation, (46)4, p. 245-250.

Hypothesis: The success of the STEEP program has earned it a status of a regional model for environmental research and education.

Type of conservation practices:

- Tillage and plant management
- Using crop cultivars with morphological characteristics that produce high yields and reduce soil erosion
- Integrated pest control
- Integrated technology transfer research
- Improving the accuracy of prediction of erosion-runoff processes and using this information in on-farm decision-making for planning conservation control applications.

Sample: The three Pacific Northwest States – Idaho, Oregon, and Washington States.

Measures:

1. Number and variety of research and extension programs developed
2. Change in farmer attitude toward conservation
3. Implementation of erosion control practices by farmers
4. Development of superior tillage and plant management practices

Results:

1. Farmers now exhibit a positive attitude toward erosion control and implementation of appropriate practices
2. A variety of cooperative research and extension programs in the three states
3. A consistent research effort has been developed
4. A consistent system of providing information to farmers has also been established
5. Development of integrated technology transfer system that produce and distribute supportive educational materials and publications to farmers
6. Conservation tillage systems and management practices that significantly reduce erosion in the three states have been developed.

20) RESMAN: A tool for soil conservation education.

(RESMAN stands for "Residue Management. It is a computer-based decision support program for crop residue management that combines current information available for residue decomposition in the field with the influence of tillage and other operations on residue burial. This information is then used to assess crop residue cover, and then plan for crop management accordingly.)

Citation: Scott D. E. (1991) Journal of Soil and Water Conservation, (46)5, p.332- 333.
Hypothesis: RESMAN offers a more accurate tool than crop yield estimates for planning crop management activities.
Type of conservation practices:

- Crop management
- Fall tillage using various implements
- Conservation planting techniques

Sample: Farm managers and other people working in agriculture and related industries
Measures:

1. Predicted mass of residue cover in pounds per acre
2. Observed mass of residue cover in pounds per acre

Results: The chart drawn for wheat, corn, and soybean showed an almost perfect positive correlation (value=1) when predicted mass was plotted against observed mass. This demonstrated the accuracy of RESMAN in assessing residue cover for appropriate planning of residue management activities.